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(54) Title: WIRELESS REMOTE SWITCHING SYSTEM

(57) Abstract

A wireless remote switching system having a transmitter (12) with a telephone keypad (12A) for a user to enter digits via the keys. The transmitter also has a microphone (12C) into which the voice of the user can be directed. The transmitter broadcasts DTMF tones generated from the user's keypad input, or it will broadcast the voice of the user, depending of the user's input to the transmitter. The system also includes a receiver (14) that detects either the broadcast DTMF tones or the voice of the user. After detecting the broadcast, the receiver digitizes the broadcast it has received. The data is then compared to previously stored data kept in the receiver's memory. If a match occurs, the receiver (14) will send a signal to throw a switch associated with an electrical appliance, such as a garage door opener (22), to regulate the power to the appliance.

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WIRELESS REMOTE SWITCHING SYSTEM

BACKGROUND

1. Field of the Invention

This invention is generally in the field of remote control by wireless radio link and is more particularly related to transmitters capable of sending sound to a receiver by wireless radio link, which receiver decodes the sound and activates switches when the decoded sound matches a predetermined sound.

2. Background Art

Remotely controlled switch throwing is in public use in a variety of settings. Examples of remotely controlled switch throwing which are of particular interest to the present invention are those involving consumer garage door opening systems.

Consumer garage door opening systems are activated by a transmitter unit which transmits at a frequency recognized by a receiver. The receiver is mounted in electrical communication with a garage door movement mechanism. When the receiver obtains a recognized code at the recognized frequency which has been transmitted from the transmitter, the receiver initiates the throwing of a switch. Once the switch is thrown, electrical power to the garage door movement mechanism is regulated. Regulation of the power to the garage door movement mechanism causes the garage door to open, stop, or close.

A great number of conventional garage door opening systems are in use today. For these systems to properly function, an initialization procedure is conducted. Initialization requires that both the frequency and the code at which the transmitter transmits must be coordinated with the frequency and the code at which the receiver is tuned to receive and recognize.

The frequency is generally hard wired in both the transmitter and the receiver. In order to accomplish the code matching between transmitter and receiver units, each unit has switch arrays that must be correspondingly set to select the same code. In this sense, the switch arrays enable code selection.

The switch arrays can be provided to the transmitter and receiver in a variety of forms. Most recently, the units have been provided with conventional eight pin dip switch components which are correspondingly set on each unit to select a matching code therebetween. Older receivers have been provided in the past with a plastic punch-out

template or with wires to cut, which punching-out and wire cutting must in turn correspond to either a dip switch setting or a similar template/wire arrangement on the transmitter.

The eight pin dip switch component has a limitation of 256 possible settings, which settings may be changed by re-setting the dip switches. As for plastic templates and wire cutting arrangements, it is much more difficult to change the settings once the initial wires have been cut or the plastic template has been punched out. This difficulty in re-setting of the latter type, as the limited number of code selections in both types, tends to be fundamental limitations of such devices for security purposes.

Once the dip switch setting, template punching-out, or wire cutting correspondence between the transmitter and the receiver is accomplished, the code selection and matching initialization function is complete.

The described code matching procedure is required in order to initialize the respective transmitter and receiver units for use together. Once the units have been so initialized, they need not be re-initialized, adjusted or otherwise fitted with respect to code settings. From thence forth, the units will function on the one radio frequency and code.

After the aforementioned manual code selection and matching initialization procedures, the transmitter is typically used with the receiver unit by manually pushing a button on the transmitter. The button causes a radio signal to be broadcast at the selected and matched frequency and code. The receiver detects the incoming signal, detects a matching code, and interprets the signal as a command to close or throw a switch, usually by means of relays and drivers therefor. The closing of the switch causes electrical power to be regulated at the garage door movement mechanism so as to affect the aforementioned garage door movement.

The typical garage door system transmit unit has only one button to make a transmission to the receiver unit. Thus, after the initialization procedure, only one code at one frequency can be sent from the transmitter.

The conventional transmitter provides a certain degree of convenience to the user. The transmitter user need press only one button to send only one code at only one frequency. Post initialization, no other code at any other frequency is sent.

The convenience of having only one button to open the user's garage door is provided at the expense of the loss of providing important safeguards. By way of example, many garage door opener system users keep the transmit unit in their

automobiles. This is done so that the garage door may be opened quickly, while still driving the car, by the mere push of a button. Once the transmitter user has opened the garage door, access to the inside of the house has been gained. Since the transmitter has no security codes which must be entered prior to pressing the transmit button, any one who presses the button will also gain access to the inside of the house.

Should the transmit unit be taken or otherwise stolen from its storage place inside of the user's automobile, the one in possession of the transmitter then has as much access to the inside of the house as if the key to the house had been taken. This lapse in security precautions is paradoxical in that a transmit unit user who would make habitual efforts to keep a set of house keys out of sight in an automobile would not also conceal the transmitter. Thus, it would be an improvement in the art to provide a garage door opening system that limited the access of the transmitter user to activation of the garage door movement mechanism.

A further breach of security is probable with conventional transmit units. Specifically, the probable breach lies in the fact that it is relatively easy to open a compartment on the transmitter which houses the dip switch component. Observation can then be made of the dip switch settings in the transmit unit. The switch component observer can then purchase a replacement transmitter which is available at consumer prices at retail hardware stores, set the dip switches on the replacement transmitter identically with those in the original transmit unit, and then gain access to the inside of the house by use of the replacement transmitter which has now been initialized to send the same code at the same frequency as the original transmitter.

With respect to purchasing replacement transmitters, conventional garage door opener manufacturers commonly make replacement units that are frequency compatible only with their own makes and models of garage door opener receiver units. Thus, it would be an improvement in the art to produce a transmitter and associated receiver that would be compatible as a retrofit with all makes and models of conventional garage door opener systems.

A convenience of conventional garage door opener systems is that the transmitter activates the opening, stopping, or closing of the garage door with the simple action of pushing a single button. The present state of the art would be improved by a device that electronically controlled the access of the transmitter user to such garage door movement, while at the same time retaining the ease and simplicity of the single button activation found in conventional systems.

In addition to the garage door opening systems described above, the consumer electronics market has recently offered other remote control devices using wireless links to regulate electrical power to lamps and lighting, ceiling fans, and other household appliances which plug into an electrical power outlet. The systems used in remote control of this type are quite similar to the conventional garage door opening systems in that a single frequency and code is used. Again, the code is set during an initialization step by setting the dip switch pins in both the transmitter and the receiver. As in the conventional garage door opener systems, there are limited security codes against access to the transmitter being used to control the household appliances due to the use of dip switch usage.

A further problem exists with the control of household appliances with such conventional transmitters. Specifically, if more than one appliance is desired to be independently controlled of other appliances, then more than one transmitter must be purchased for such independent control, or else the transmitter dip switches must be changed to select the matching code of the receiver associated with the household appliance which is desired to be independently controlled. Without an extra transmitter or the efforts to change the dip switch setting in a single transmitter, independent appliance control would not be accomplished. This problem is particularly acute for houses having two garage doors, where the conventional solution to separate garage door activation has been to provide two different transmitters having two different codes to activate the two different garage door opener system receivers. Accordingly, it would be an advance in the art to provide a single transmitter that would be able to independently control more than one receiver unit without initialization of the transmitted code through dip switch settings, where each such receiver unit is associated with a household appliance and through which the electrical power thereto is regulated.

It would be a further improvement in the consumer electronic arts to achieve the above desired improvements through the use of commercially available microprocessors and other semiconductor parts so as to produce the invention economically and squarely so within the domain of consumer household appliances.

BRIEF SUMMARY OF THE INVENTION

In accordance with the invention as embodied and broadly described herein, there is provided a wireless link remote controlled switch throwing system having a transmitter and a receiver, where the receiver is in communication with a means for throwing

switches. A user inputs security access data to the transmitter. The security access data is modulated on a carrier signal and transmitted to the receiver.

The receiver demodulates the modulated security access data that was received from the transmitter. The receiver has a means for decoding the demodulated security access data. The output of the decoding means is compared with security codes stored in the receiver in a means for storing security codes. If the comparison shows a match therebetween, the means for throwing switches will be activated.

The transmitter has an input means, such as a keypad, for inputting codes. The input codes may in turn be used to generate dual tone multifrequency (DTMF) signals via a DTMF chip. The DTMF signals are then input to a means for modulating signals. The output of the modulating means is then transmitted by the transmitter to the receiver.

The transmitter may also be provided with a means for data storage. When so provided, the input codes are stored at an address in the data storage means. After such storage, and upon user demand, the contents stored at the address in the data storage means is transmitted to the receiver.

The input means of transmitter may also be, or may be in lieu of a keypad, equipped with a microphone. When so equipped, the user may direct a sound such as the user's voice into the microphone. The output of the microphone is input to the modulating means. The output of the modulating means is then transmitted to the receiver.

Where the transmitter is provided with both a data storage means and a microphone, the output of the modulating means will be input to the data storage means and stored at an address therein. Upon user demand, the contents stored at the address in the data storage means is transmitted to the receiver.

A preferred embodiment of the invention features a transmitter transmitting digitized security access data to a receiver, where the transmitted digital data is originally input to the transmitter via a keypad or a microphone.

To add to the ease of use of the transmitter, a preferred embodiment of the transmitter features a last number redial button thereon. Each time a sequence of numbers is input at the keypad, the sequence is input to a means for storing the last number. When the last number redial button is depressed, the contents of the means for storing the last number is output to the modulating means, just as if the stored sequence were input at the keypad. The normal transmit function then proceeds. Once the proper security code for the receiver has been stored in the means for storing the last number,

the keypad need not be used again and the only button that will be needed to operate the transmitter is the last number re-dial button. Thus, the last number re-dial button provides the transmitter of the present invention with the same simplicity as the conventional single button garage door opener transmitters, yet still retains the aforementioned security aspects.

In order to prevent others from using the last number redial button, the user can enter an unrecognized code at the keypad. When the redial button is pressed, the transmitted code will not be recognizable by the receiver and the access security will have been maintained.

In preferred embodiments of the receiver, the receiver may optionally be equipped with a means for inputting codes, such as a keypad, a microphone with amplifier, or both. Codes that are input to the keypad are used to generate DTMF signals via a DTMF tone generation chip that may be in the receiver. Sounds input to the microphone are also considered herein to be input codes. The DTMF signals, or the amplifier output from the microphone from sound received thereat, are then stored in the means for storing security codes. By so storing security codes in the security code storage means, comparisons can be made with demodulated data received from the transmitter to determine if there is a match therebetween. A match is the event which initiates the activation of the means for throwing switches.

In another preferred embodiment of the receiver, the receiver has no keypad or microphone. However, a predetermined string of security access data received from the transmitter will cause the receiver to be put into a "PROGRAM" mode. This "PROGRAM" mode is initiated by the input of the incoming stream of modulated security access data from the transmitter to a demodulating means, and then to a means for decoding data. The output of the decoding means is compared with a predetermined code sequence stored in the receiver, such as via a factory preset hard coding, at an address in a means for storing security codes. If the comparison shows a match therebetween, the "PROGRAM" mode will be initiated.

After the setting of the "PROGRAM" mode, a second incoming stream of modulated security access data from the transmitter will be stored at another address in the means for storing security codes in the receiver. After the storage of the second incoming stream of digital data from the transmitter, the receiver will exit the "PROGRAM" mode and will then be ready to perform the above described role of comparing access security codes received from the transmitter with the previously stored

second incoming stream of digital data. Again, if a match therebetween is found in the comparison, activation of the means for throwing switches will take place.

By establishing the above function and structure, a user can safe guard when the switch throwing means is activated. By way of example, and not by way of limitation, the receiver can be programmed to activate the switch throwing means only upon receipt of a unique seven digit number, only upon receipt of the sound of a specific person's voice speaking a specific word-phrase combination, or only upon receipt of a unique electronically produced sound.

In yet another preferred embodiment, the receiver can be programmed to activate the switch throwing means by the receipt of several different security access codes. Thus, the receiver might be programmed to activate the switch throwing means only for a specific person's voice speaking a limited word-phrase, while also being able to activate the switch throwing means by specific keypad input sequences. An example of this would be that the owner of the transmitter would program the receiver to "recognize" only the word-phrase spoken by the owner, yet still accept keypad input from anyone else. So programmed, the owner can lend out the transmitter to be used by persons who must input the correct security codes to the key board to throw switches, while permitting only the owner to use the voice activation capability. Thus, the owner need only remember a mnemonic word-phrase rather a number sequence which may be difficult to commit to memory.

A further preferred embodiment of the inventive system involves the storage of a digitized word-phase sound spoken by a specific person, a series of analog sounds generated by a DTMF tone generation chip, a series of digitized sounds generated by a DTMF tone generation chip, or other unique digitized sound image, which storage is fixed in both the receiver and the transmitter. After such storage, a predetermined button is depressed to transmit the stored digitized sound image and a match thereto is detected with the counterpart receiver storage. As above, the match instigates the activation of the switch throwing means. The digital transmission and reception of the comparison codes enables increased accuracy.

Another preferred embodiment of the invention features a sound scrambler which encrypts the transmitted security access data. The receiver has the appropriate encryption key to descramble or otherwise decode the scrambled sound image and then seek a match with the decoded sound image. Thus, a secure link is achieved for tighter access control between the transmitter and activation of the switch throwing means via the receiver.

BRIEF DESCRIPTION OF THE DRAWINGS

In order that the manner in which the above-recited and other advantages and objects of the invention are obtained, a more particular description of the invention briefly described above will be rendered by reference to specific embodiments thereof which are illustrated in the appended drawings. Understanding that these drawings depict only typical embodiments of the invention and are therefore not to be considered limiting of its scope, the invention in its presently understood best mode for making and using the same will be described with additional specificity and detail through the use of the accompanying drawings in which:

Figure 1 is block diagram of a preferred embodiment of the transmitter;

Figure 1A is a schematic diagram of a portion of another preferred embodiment of the transmitter, which embodiment is shown in Figures 1A, 1B, and 1C, with Figure 1A featuring an RF oscillator, a DTMF dialer with a last number re-dial component, and an external clock oscillator;

Figure 1B is a schematic diagram of a portion of the preferred embodiment of the transmitter shown in Figures 1A and 1C, with Figure 1B featuring a battery cell circuit, a voltage doubler circuitry, a program switch. a diode OR-ing logic circuit, a last number re-dial switch, and a keypad;

Figure 1C is a schematic diagram of a portion of the preferred of the transmitter shown in Figures 1A and 1B, with Figure 1C featuring a row column array of switched for the keypad;

Figure 2 is block diagram of a preferred embodiment of the receiver;

Figure 2A is a schematic diagram of a portion of another preferred embodiment of the receiver, which embodiment is shown in Figures 2A, 2B, 2C, and 2D, with Figure 2A featuring an antenna, a resonate network circuit, local oscillator circuitry, mixer circuitry, an IF amplifier circuit, and AM detector circuit, amplifier circuitry, and a V+ circuit;

Figure 2B is a schematic diagram of a portion of the preferred embodiment of the receiver, shown in Figures 1A, 2C, and 2D, with Figure 2B featuring a Voice Recognition Chip (VRC), a voice data memory chip; and a VRC latch chip;

Figure 2C is a schematic diagram of a portion of the preferred embodiment of the receiver, shown in Figures 2A, 2B and 2D, with Figure 2C featuring a command decoder circuit, an outside power source interface, and a portion of dual display decoder/driver circuits;

Figure 2D is a schematic diagram of a portion of the preferred embodiment of the receiver, shown in Figures 2A, 2B, and 2C, with Figure 2D featuring relay and driver circuitry and a portion of dual display decoder/driver circuits; and

Figure 3 is a perspective view of a preferred embodiment of the inventive wireless remote switching system showing a transmitter and a receiver, the system being retrofit to a conventional garage door opener system by being in electrical communication with the leads of a conventional garage door manual activation button, and the manual activation button being associated with a conventional garage door movement mechanism.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The inventive wireless remote switching system is comprised of a transmitter means for broadcasting a carrier frequency. The transmitter means comprises a means for inputting a new sound image data set, means for modulating the new sound image data set to produce a modulated sound image data set, means for broadcasting the carrier frequency with the modulated sound image data set superimposed thereon, and means, manually operable, for initiating the modulating means to produce the modulated sound image data set and then to initiate the broadcasting means to broadcast the carrier frequency with the modulated sound image data set superimposed thereon.

Referring now to Figure 1, by way of example and illustration, the transmitter means is depicted. Figure 1 shows an example of the means for inputting a new sound image data set, shown by the keypad at 12A and the microphone and amplifier at 12C.

To illustrate an example of the means for modulating the new sound image data set to produce a modulated sound image data set, a single transistor R.F. oscillator with modulator is shown at 70A, and the means for broadcasting the carrier frequency with the modulated sound image data set superimposed thereon is shown as antenna 75A. The means, manually operable, for initiating the modulating means to produce the modulated sound image data set and then to initiate the broadcasting means to broadcast the carrier frequency with the modulated sound image data set superimposed thereon is shown by way of example of same as a DTMF dialer with last number redial capability at 80A.

The transmitter means may further comprises a wrap-around memory means for storing the new sound image data set at an address of a previously stored sound image data set. An example of this feature is shown in blocks 80A and 80C in Figure 1, respectively, in the last number redial facility and the sound storage circuit.

The transmitter means may also have a digital keypad means for accepting input of a string of digits input by a user of the digital keypad. Figure 1 shows keypad 12A as an example of the digital keypad means. Further, a means for generating a string of analog DTMF signals from the new sound image data set stored in the wrap-around memory means, and for modulating the string of analog DTMF signals to produce the modulated sound image data set may be included in the transmitter means. Examples of these functional features are shown in block 80A in the DTMF dialer, and in block 70A as the modulator.

A microphone means for detecting and amplifying an auditory sound image data set to produce an amplified auditory sound image data set can be a part of the transmitter means. Figure 1 shows microphone and amplifier 12C as an example of this functional capability.

After receiving an analog auditory signal from the microphone means, the transmitter means may have an audio digitizing means for digitizing the amplified auditory sound image data set to produce a digitized auditory sound image data set, and a means for storing the digitized auditory sound image data set at the address of the previously stored sound image data set. To illustrate examples of these functions, block 80C of Figure 1 shows a sound storage circuit for such purposes.

The transmitter means may also have a means for digitizing the string of analog DTMF signals to produce a string of digitized DTMF signals, and a means for storing the digitized DTMF signals at the keypad address of the previously stored sound image data set. Again, block 80C features a sound storage circuit as an example and illustration of such options to the transmitter means of the inventive wireless remote switching system.

As mentioned, transmitter 12 may include a means for digitizing the data input thereto, such as DTMF tones or voice sounds, where the data transmitted by transmitter 12 is required to be digitized prior to such transmission.

The inventive wireless remote switching system also comprises a receiver means for receiving the carrier frequency broadcast from the transmitter means. The receiver means comprises a means for digitizing sound images, a means for storing digitized sound images, and a security code input means for receiving a predetermined sound image data set.

The receiver means also includes a programming means for causing the sound image digitizing means to accept the predetermined sound image data set and to output therefrom a digitized predetermined sound image data set, and for causing the means for

storing digitized sound images to store therein the digitized predetermined sound image data set. Further, the receiver means has a means for demodulating the modulated sound image data set superimposed on the carrier frequency to produce a demodulated sound image data set, a means for inputting the demodulated sound image data set to the means for digitizing sound image data so as to output therefrom a digitized received sound image data set, a means for determining the existence of a match by a comparison of the digitized received sound image data set with the digitized predetermined sound image data set, and a relay means, in electrical communication with the determining means, for throwing a switch when the determining means determines the existence of the match by the comparison.

Referring now to Figure 2, by way of example and illustration, a receiver means is depicted by block diagrams. Figure 2 illustrates, at the block 40 as the Voice Recognition Circuitry, an example of the means for digitizing sound images, the means for storing digitized sound images, the programming means for causing the sound image digitizing means to accept the predetermined sound image data set and to output therefrom a digitized predetermined sound image data set, and for causing the means for storing digitized sound images to store therein the digitized predetermined sound image data set.

Figure 2 also depicts at RF receiver block 20, examples of the means for demodulating the modulated sound image data set superimposed on the carrier frequency to produce a demodulated sound image data set, and the means for inputting the demodulated sound image data set to the means for digitizing sound image data. Figure 2 also shows, in Voice Recognition Circuitry block 40, an example of the means for digitizing sound image data for outputting therefrom a digitized received sound image data set, and the means for determining the existence of a match by a comparison of the digitized received sound image data set with the digitized predetermined sound image data set.

As an example to illustrate the security code input means for receiving a predetermined sound image data set, Figure 2 shows keypad 14A and microphone 14C. Also, the receiver means includes a relay means, in electrical communication with the determining means, for throwing a switch when the determining means determines the existence of the match by the comparison, an example of which is depicted in Figure 2 as blocks 700A, 750, 800A.

The receiver means may also include a digital keypad means, as described above, for accepting input of a string of digits and for generating therefrom the predetermined sound image data set comprising a string of analog dual tone multifrequency (DTMF) signals from the string of digits input at the digital keypad means. By way of example and illustration of these functional aspects of the receiver means, Figure 2 depicts keypad 14A which has the capability of generating receiving a string of analog DTMF signals from the string of digits input thereat.

The receiver means may also include a microphone means for detecting and amplifying an auditory sound image data set to produce therefrom the predetermined sound image data set, which is shown by way of example of same as microphone 14C in Figure 2.

The receiver means may have a means for visually indicating reception and storage therein of data received from the transmitter means, which visual means may also be used to visually display diagnostics. An illustration of the visual means may be, for example, display decoder driver 1000A and command decoder 900A shown in Figure 2.

For the purpose of illustrating one practical example of the inventive wireless remote switching system, Figure 3 is now referred to in which an example of the transmitter is shown at 12. The transmitter keypad 12A and the transmitter microphone/amplifier 12C are mounted on transmitter 12.

The receiver is shown at 14. Mounted on receiver 14 is a receiver keypad 14A and a receiver microphone/amplifier 14C. Receiver 12 has a pair of switch throwing leads 16 in electrical communication with a contact switch 20. Contact switch 20 serves the purpose of closing in order to electrically connect the leads 18. Manual button 38, which is conventional on most garage door opening systems, is depressed to regulate power to garage door opener movement mechanism 22. When contract switch 20 closes, power travels through leads 18 to garage door movement mechanism 22 in order to move the garage door 24, thus by-passing the manual button 38.

To operate the wireless remote switching system of Figure 3, a user 40 depresses a predetermined sequence of numbers, preferably up to seven, on the keys of transmitter keypad 12A. The numeric sequence is stored as the last number dialed in a memory location in the transmitter. When the last-number-redial button 12D is depressed, the transmitter uses its memory location and the last numeric sequence stored therein to code, modulate and transmit the sequence to the receiver.

Alternatively, user 40 could also direct a specific sound 40A to the transmitter microphone/amplifier 12C, while depressing the "*" key, the "#" key, or another key located on keypad 12A, so as to initiate the transmission of the specific sound. When the aforementioned buttons are manually depressed, the tones generated from last number sequence input on keypad 12A, or the specific sound input to microphone 12C, are modulated by transmitter 12 and broadcast by an antennae therein to receiver 14. The manual button, so depressed, is one example given to illustrate the functional aspect of the transmitter means for a means, manually operable, for initiating the modulating means to produce the modulated sound image data set and then to initiate the broadcasting means to broadcast the carrier frequency with the modulated sound image data set superimposed thereon.

It is preferable that the transmitter comprises a low power intentional radiator in the 300MHz to 400MHz range. Modulation for the transmitter should preferably also utilize a unique scheme of DTMF tone sounds in either AM or FM modulation, which DTMF tones are generated from digits which have been input at keypad 12A. A standard DTMF chip is preferable, such as a Fujitsu MB87007FPT, with a last number redial capability. Last number redial button 12D, or the "*", "#", or other character on keypad 12A may be depressed to initiate the last number redial function. Preferably, transmitter 12 will be programmable as to the function of each keypad button thereon.

As mentioned above, a sound storage circuit, generally indicated at 80C, can also form a part of transmitter 12. Sound storage circuit 80C stores sound images therein, in digital or analog form, for later modulation and transmission to receiver 14. An example of such a storage circuit is a semiconductor device from the ISD2500 Series sold by Information Storage Devices of Austin, Texas. The ISD2500 series provides high-quality, single-chip record/playback. On board these CMOS chips is an oscillator, microphone preamplifier, automatic gain control, antialiasing filter, smoothing filter, and speaker amplifier. Further, the ISD2500 series is fully microprocessor compatible so as to allow for sophisticated messaging and addressing. Conventional support circuitry to an ISD2500 series chip could scramble the sound image, as previously discussed, for a more secure transmission.

Referring now to Figure 1, there is depicted the block diagram of transmitter 12. Figure 1 shows a block diagram of the RF oscillator/modulator 70A which provides the RF carrier for the transmitter.

The next block in Figure 1 is the DTMF dialer/sound storage circuit 80C. In the case of DTMF, a chip generates DTMF tones through initiation of same by a user pressing a last number redial button on keypad 12A. In the case of sound storage of digitized DTMF sounds or other sounds, a chip generates previously stored sound through initiation of same by a user pressing, respectively, last number redial button 12D, or a voice-transmit-key on keypad 12A, the latter of which may be any key on keypad 12A so programmed by transmitter 12.

In Figures 1A and 1B, another preferred embodiment of the transmitter is shown in which key pad 12A is preferably a column row keypad matrix. Figure 1B shows the main button 48A for the last number redial function, which is comprised of S1A and S1B. Main button 38A has to do two functions at the same time. Similar to conventional tone generation telephone concepts, main button 8A has to perform an 'off hook' function, and it also has to perform a 'last number redial' function at the same time.

The program switch 44A is seen in Figure 1B. Program switch 44A throws switch S2 to go 'off hook' and to enable user 40 to enter a new security code so as to program receiver 14 to accept as new validation passcode. Receiver 14 will store the new passcode and will use the stored passcode against which to check new attempts to gain access to the switch throwing means via the receiver through user 40 use of transmitter 12.

Figures 1 and 1B both feature the voltage doubler 50A, 50B as part of the power supply to transmitter 12. The battery 43A provides three volts which are doubled by voltage doubler 50B to produce six volts to the VCC system of transmitter 12.

Figures 1 and 1A both feature the RF oscillator 70A, 70B and the FM transmitter 70C. RF oscillator 70A, 70B functions as does a local oscillator. In Figure 1A, L2 and C6 are an RF choke to prevent RF from getting back out onto the power supply. L1, C3, and the output capacitance of Q1 form the resident tank circuit or the primary frequency determining components. C10 and R4 determine the level. R4 also determines the DC bias current to the transistor Q1 as well as the two resistors L1, L2. R6 and R8 provide the bias to the base of the transistor Q1. C5 provides a RF by-pass to the base of the transistor Q1. R5 attenuates the injected DTMF signals from the next stage.

Figure 1A shows the DTMF dialer at U0, which may be model MMB87007FPT, shown as chip U1. Chip U1 also has some support circuitry comprised of crystal oscillator Y1. Crystal oscillator Y1 is preferably a standard color sub-carrier crystal and

is used internally into DTMF chip U1 to generate the exact DTMF tones as would a conventional tone telephone.

When the program mode is entered, as described above with program circuit 44A, by keypad input on the row and column switch seen in Figure 1C, those input numbers are entered into an internal memory in chip U1. Then, when user 40 presses the redial button 14D, via circuit 48A of Figure 1B, the transmitter performs the last number redial function and the stored numbers are sequentially output from DTMF dialer chip U1 in approximately 40 millisecond dial tones. The DTMF tones are produced with approximately 40 millisecond break time in between tones. Tone duration and breaks therebetween is variable depending on how chip U1 is initialized.

Analog dual tone multi-freqüencies are then output from chip U1 which is AC coupled through C7, initiated through R5 and then fed to RF oscillator 70B.

The DTMF tones change the base voltage on transistor Q1. The voltage change then changes the current through transistor Q1, which changes the amplitude of the oscillation, and also changes the output capacitance of the device, which in turn changes the frequency of RF oscillator 70B. Thus, the modulation of RF oscillator 70B by these means produces both AM and FM modulation so that either an AM or FM detector can be used in the receiver.

An antenna 75A, 75B, seen in Figures 1 and 1A, is used to broadcast to the receiver. Preferably, antennae 75A, 75B are each a short approximately 3-inch stub and are routed as a trace around the outside edge of the PC board of the respective transmitters. Antenna 75B will preferable be connected to the emitter of transistor Q1 through a 100 Ohm resistor.

Figure 1A depicts an 'OR-ing' logic circuit, generally indicated at 46A. By the diodes therein, DTMF chip U1 can be put into the mode of 'off-hook' by either one of two ways. These two ways are by either switching the S2 switch which is program switch 44A, or pressing the main button which is main button circuit 48A.

The transmitter has a power supply, with a voltage doubler circuit 50B, and a three volt lithium button battery 42B which is preferably approximately the size of a quarter dollar. Battery 42B provides power continuously through the signal V+ through DTMF tone dialer chip U1.

When the main button is pushed, via circuit 48A, a connection is made from the three volt battery 42B to chip U2, in voltage doubler circuit 50B. Voltage doubler circuit 50B preferable includes components are C11, C12, and D1 which function with chip U2

to provide 6 volts to RF oscillator 70A, 70B. Battery BT1 provides voltage V+ constantly to chip U1.

Figure 1C shows switches associated with the transmitter keypad 12A in a row column configuration much like the first nine digits of a conventional telephone key pad. Alternatively, the keypad could comprise individual switches connected across the row column inputs of the dialer chip U1.

In another preferred embodiment of the invention, transmitter 12 has microphone 12C as seen in Figures 1 and 3. The microphone could be any kind of microphone. In substitution for DTMF chip U1, which currently provides analog tones in the frequency range of 200Hz to 4KHz or basically in the audio band of normal hearing range, a replacement therefor could be made with microphone/amplifier 12C that would boost that signal up to approximately one volt peak to peak. As a variation of this further preferred embodiment, transmitter 12 includes a digital storage chip that would take microphone/amplifier 12C input to record voice sound image or any other audio type tones. As described above, the ISD2500 series chip could serve as the digital sound storage chip. An analog-to-digital conversion would be preformed so as to store the digital result in silicone memory in the digital sound storage chip. Upon initiating the last number redial feature or other sound reproduction button, the digital data stored in the silicone memory 80A can be recalled at the same rate as the original sound or at different rates. After recall, the device would then change the digital sound image back to an analog sound image so that it again would be an analog signal being fed to RF oscillator 70A. The signal would preferably be conditioned so that it was approximately one volt peak to peak. Alternatively, the sound image data stored in silicone memory could be transmitted in digital format, without being converted by the analog.

Referring to the previously stated embodiment, there is an advantage to transmitting digitally rather than transmitting in analog. For instance, digital voice scrambling could be affected to increase security of the transmission. Actual digital data could be sent in this way. Any number of methods of voice scrambling could be performed, making it difficult to ever reproduce a user's voice or other transmitted sound image.

Figure 2 shows a block diagram of a preferred embodiment of the receiver. Illustrated in Figure 2 is resonate network 100A which is a series resonant LC network which selects a preferably narrow band of frequencies. In this case the frequency that is

desired to be received is that of the transmitter carrier frequency, which is between 300 and 400MHz.

Figure 2 further illustrates the local oscillator 200A. Local oscillator 200A is an oscillator on-board of receiver 14 that generates a frequency close to the transmit frequency broadcast from of transmitter 12. Preferably, the difference therebetween will be approximately 10MHz.

The output of local oscillator 200A is injected into mixer 300A with the receive frequency for a heterodyning process. The output of mixer 300A is the difference between the broadcast transmitter frequency and the local oscillator frequency.

The next stage shown in Figure 2 is the IF amplifier 400A which takes the output of mixer 300A, which is preferably approximately 10MHz, and amplifies it via IF amplifier 400A. If amplifier 400A is a wide band amplifier. The output of IF amplifier 400A is passed to an AM detector 500A. The output of AM detector 500A is an auto signal which is amplified further by a linear amplifier. The linear amplifier takes the audio and boosts the level out to the range that will be useful to the voice recognition circuity U0, or approximately 50 millivolts peak to peak.

Voice recognition circuitry U0 is shown in Figure 2, which has the function of taking in voice or audible sound spectrum data, which is from 200Hz to about 4Khz in frequency. U0 includes a means to store a voice message for later comparison with another sound image. When a later sound image is taken into voice recognition circuitry U0, voice recognition circuity U0 uses a means to compare the later image to the previously stored sound image in memory. If a match occurred therebetween, then a means to indicate such match would be activated.

The first section of voice recognition circuitry U0 is the VRC chip U1 seen in Figure 2. An audio input, which is receiver microphone 14C, and a number input, which is receiver keypad 14A, are also shown in Figure 2. Several ways exist of storing passcodes in the U0 circuitry. By way of example, and not by way of limitation, a number sequence could be entered on receiver key pad 14A to put the receiver into a program mode during which passcodes could be stored in the U0 circuitry. During the program mode, sound could be directed into receiver microphone 14C. The sound image thereof could be then digitized and stored as a passcode for future comparisons. Acknowledgement of such proper storage can be indicated audibly back to the user of receiver 14 via a sound producing electrical component or other sensory means such as visual displays DISPL1, DISPL2 of Figure 2. Voice recognition circuitry U0 may also

comprise conventional support circuitry to descramble transmissions from the transmitter that were scrambled prior to transmission.

Preferably, voice recognition circuitry U0 will have at least 40 memory locations to store passcode data against which it can make future comparisons so as to discriminate between incoming transmissions from transmitter 12 and the passcodes in storage in U0. Also, a different data set should be stored in each of the 40 memory locations.

Output of VRC chip U1 passes to the voice data memory circuit U2. The output thereto may be voice data or tone data or voice spectrum data. VRC chip U1 preferably will digitize the output to voice data memory chip U2 where the digitized output is stored as a passcode for later comparison with subsequent transmitted sound image data from the transmitter. The passcode storage mode is called herein the program mode and the mode in which comparisons are made between stored passcodes in voice data memory U2 and incoming transmissions is called herein the recognize mode.

When the broadcast transmission of sound image data from transmitter 12 does not result in a match with passcodes in voice data memory U2, no electrical signals are output downstream to the command decoder 900A. Matches result in the issuance of an electrical signal command being directed to command decoder 900A and from thence to the relay circuits 700A, 800A. Such commands are further discussed below.

The VRC latch U3 is a locking circuit. As the VRC chip goes through the recognition mode, it will put data out on a data bus, which VRC latch U3 is connected with. The output data will contain the passcode that it has recognized. VRC chip U1 will strobe VRC latch U3 when a passcode is recognized or matched with digitized transmission data. Once so matched, the passcode is stored into VRC latch U3.

The output of VRC latch U3 is connected to a dual hexadecimal display decoder driver circuit 1000A which transforms hexadecimal data into seven segment readout data called herein hexadecimal seven segment displays. Display decoder driver 1000A uses VRC latch U3 data and converts the latch data to visually displayed indicia upon DISPL1 and DISPL2. Visual indicia is also displayed upon DISPL1 and DISPL2 for diagnostic information, such as when the receiver enters the program mode and will display thereat the register number of the voice data memory chip U2 into which there is being a passcode stored. As to the later function, the command decoder 900A takes data output from VRC latch U2 and compares the latch data to a word register number corresponding to a command to be performed.

Whenever voice recognition circuit U0 in Figure 2 sends out a word register number, command decoder 900A will recognize that as a match with the preset word registers. Subsequently, command decoder 900A will activate relay circuitry 700A, 800A by giving a pulse out to the relays to close them and actuate whatever remote devices are connected to the relays. Commands are issued to the relays for a remote device when the desired register number in comparison is a match.

Relay circuitry 700A, 800A is a relay bank having at least one relay, and more relays for more than one function desired to be performed by receiver 14. Relay drivers 800A are provides for each relay in relay bank 700A.

Seen in Figure 2 at 750A is a screw barrier terminal strip which may be used to connect receiver 12 to the electrical leads of an appliance such as leads 18 of garage door movement mechanism 22. Strip 750A serves as a switch contact.

Functionally, whenever command decoder 900A matches VRC latch U3 data comprising a preset register number, command decoder U3 generates a pulse to relay driver 800A. This pulse will then close the relay for a brief period of time, such as 5 or 10 milliseconds and then open the relay. This fast open and close sequence simulates pushing and releasing the button on a conventional garage door opener to open the garage door.

In an alternative and preferred embodiment, the relay could stay closed or stay open in a set-reset function other than the pulse function of the previous embodiment. In a set reset function, the relay will set and it will stay set in a RS-type latch function. In other words, a switch will close and stay closed. The next time the relay gets a pulse, it will reset or the switch will open up again. A practical example of this function is the use of the inventive remote switch system to turn power on or off to an electrical appliance.

Having dealt with the receiver embodiment of Figure 2, another embodiment of the receiver, as shown by electrical schematic diagrams 2A through 2D, will now be dealt with.

Referring now to Figure 2B, the keypad connector JP1 is shown with pins one through thirteen. Chip U1 is an analog VRC chip, chip U2 is the voice data memory chip, and chip U3 is the VRC latch chip. VRC chip U1 requires 12 digit input keys on the keypad associated therewith, as well as a train key and a clear key, for a total of 12 keys. Accordingly, the receiver keypad is preferably a 12 key keypad which can be any type of column row encoded matrix type keypad and similar to conventional telephone

keypads. Keypad connector JP1 physically connects such a receiver keypad, which may be similar to keypad 14A in Figure 2, to VRC chip U1. Such a keypad could be used to put the receiver into the "PROGRAM" mode via a designated train key.

VRC chip U1 is preferably a model number HM2007DIP by Hualon Micro Electronics Corporation of Taiwan and distributed through The Summa group. Pin GND is the ground reference for chip U1. Pins X1 and X2 are the crystal oscillator input and output pins. VRC chip U1 requires a time base frequency produced by a crystal operating at 3.5795454MHz. The crystal X1, which is connected to pins X1 and X2, is a conventional color burst crystal. Audio pin 46 is the pin at which the voice spectrum frequency data is received into VRC chip U1. The input at pin 46 has a sensitivity level from 30 millivolts peak to peak. Internally, VRC chip U1 does filtering, ban pass filtering, alias filtering, and automatic gain control of the sound image or voice data coming in. As the voice data comes in, it is digitized. The digitizing process in VRC chip U1 samples the frequency data and breaks it up into 8 bit words. VRC chip U1 automatically generates memory addresses, outputs digitized voice data, and has control lines to voice data memory chip U2 to store the digitized data in chip U2.

After the digitizing process in chip U1, the digitized voice data is then passed onto voice data memory chip U2 where the digitized voice data will be stored. Access to the stored digitized data in chip U2 is coordinated via memory address lines. Voice data memory chip U2 has address lines for 64,000 addresses built into chip U2. Each address is toggled up and down to access a specific address. Chip U2 has a data bus through which the digitized voice data is passed on to VRC latch U3.

When VRC chip U1 finishes a command, be it in the training mode command or a recognition mode command, chip U1 will output data onto the data bus between chips U1 and U2. That data is then stored into the voice register latch which is chip U3. The voice register latch chip U3 is divided up into maximum of 40 different voice registers so as to have up to 40 different words trained into VRC chip U1. Preferably, each of the 40 words will be different. The data that goes into chip U3 will identify which register has either been recognized or trained as per the mode operation. In one mode of use, a designated train key on the keypad is depressed to enter the train or "PROGRAM" mode so as to load the voice registers. Thus, the voice recognition code latch chip U3 presents data if the register of the word that has been recognized, and that data is then stored VRC latch chip U3. The stored data is used to identify which register number has been recognized and is also used to determine if a command that been

requested has been recognized, which recognition is to activate or close a relay of relay bank 700B.

Figure 2A, depicting a preferred embodiment of RF receiver circuitry in a 400MHz receiver of the inventive wireless remote switching system, is now referred to. The resonate network circuit 100B features CV2 and L5 which is a series tuned to resonate circuit. CV2 is variable in the range of 5-20 picofarads so that the frequency can be adjusted.

The mixer circuitry 300B is comprised of Q2, L4, R7, R9, L6, and CV1. L4 is an RF choke which provides a DC path for current out of Q2 to ground. R7 and R9 are a biasing network that provides a small amount of base current to Q2. L6 and CV1 are a resonant parallel tuned circuit that is tuned to the intermediate (IF) or beat frequency of the mixer. C9 is a power supply by-pass capacitor to keep the RF out of power supply 1100B of Figure 2C.

The local oscillator circuit 200B comprises L2, L3, R1, R3, C5, Q1, R2, C3, C4 and C6. L3 with C4 output the capacitance of transistor Q1 which determines the frequency of local oscillator 200B. R1 and R3 provide the bias for transistor Q1. C5 is a high frequency by-pass capacitor for the base of transistor Q1 so that the base does not move in RF frequencies. R2 determines the gain in the DC bias currents through transistor Q1. C3 determines the output level of local oscillator 200B. L2 is an RF choke which complements C6 to filter the RF so that it does not feed back into power supply 1100B of Figure 2C. R12, R7, and R9 of mixer 300B serve as a voltage divider to attenuate the output signal from local oscillator 200B. The output signal is then AC coupled via C12.

Mixer 300B is marginally bias 'ON' in the non-linear region of the base of emitter diode current vs. voltage characteristics. Local oscillator 200B then turns transistor Q2 'ON' and 'OFF' as it oscillates back and forth. As transistor Q2 goes through the non-linear exponential current-to-voltage up the base emitter junction thereof, an exponential can be approximated through a power series which starts an X-squared to approximate a multiplier in the non-linear region. Thus, mixer circuit 300B multiplies the signal output of local oscillator circuit 200B with the incoming receive signals through the antenna 36B.

The capacitor C8 AC couples the output of mixer circuit 300B into the IF amplifier circuit 400B which comprises R14, R5, Q4, Q3, R4, R6, and C13. R5, R4, and R6 provide biasing for transistor Q4. Q3 has a conventional wide band topology. Wide

band topology is preferable so that a relatively high intermediate frequency of 10MHz, inexpensive transistor Q3 is adequate in the configuration of IF amplifier 400B. C13 by-passes the base of transistor Q4 so that it does not move in RF frequencies. The output of IF amplifier circuit 400B comes from the collector of transistor Q4 and is then AC coupled into the AM detector circuit 500B. Thus, the intermediate AM modulated frequency is AC coupled by C7 into AM detector circuit 500B.

AM detector circuit 500B comprises R16, D1, R15, Q5, R17 and C10. The transistor Q5 is bias one diode drop above ground via R16 and D1. R16 provides current through D1 causing it to sit at approximately 1 silicone diode drop above ground or approximately 0.5-0.6 volts at which it is biasing out. That voltage is then superimposed to the base of transistor Q5 via R15 so as to function as an active diode rectifier with conversion gain of approximately 10 or 20. In sum, the IF modulated AM modulated frequency is impressed upon the base of transistor Q5 causing it to turns on and off and be rectified. At the collector of transistor Q5, the output is filtered so that the carrier is filtered out. The function being accomplished thereby is similar to a single side band AM detector with gain. After the carrier has been filtered out, the remainder thereof is the original audio modulation.

At the amplifier circuit 600B, the original audio modulation from is amplified by transistor Q6. The amplified audio output is then fed to the audio input of VRC chip U1.

A main V+ filter 650B is associated with the receiver circuitry V+ filter. Preferably, V+ Filter 650B is connected in the receiver circuitry close to the RF receiver circuitry 100B through 600B and away from the voice recognition circuitry U1 through U3. V+ filter 650B is comprised of RF choke L1 and C1. RF coke L1 is a high impedance at the radio frequencies of the receiver. Capacitor C1 is a shunt capacitance which is a low impedance at receiver frequencies and serves to keep RF frequencies out of power supply 1100B of Figure 2C which could cause radio emissions which might cause unwanted feedback and oscillations.

The circuit shown in Figure 2A could be replaced by a semiconductor chip made by Motorola, having a part number MC3363, in yet another embodiment of the receiver of the inventive wireless radio link switch throwing system.

After the voice recognition code latch chip U3 presents data stored therein of the register of the word that has been recognized, the command decoded driver circuitry, having chips U4, U5 of Figure 2D, and U6, U7A of Figure 2C, becomes operational. If a command is recognized, a relay of relay bank 700B will close. The display decoder

driver circuitry is composed of two hexadecimal seven segment display decoder drivers. These drivers take the data in four bits for each decoder and change each 4 bit sequence into 7 bits to drive the indicated display, DISPL1 or DISPL2. The decoder chips U4 and U5, as shown in Figures 2 and 2D, respectively drive display units DISPL1 and DISPL2 in conjunction with chip U7A of Figure 2C.

The command decoder circuitry is comprised of an eight bit magnitude comparator U6 and two binary code decimal switches SW1, SW2 of Figure 2C. The switches are set to match the desired command register or work register that is programmed to issue a requested command.

By way of example, and not by way of limitation, if the switch associated with relay bank 700B of Figure 2D is desired to be opened, a command would be stored, for instance in word register 5. Once word register 5 is stored in the voice VRC latch U3, the eight bit magnitude comparator U6 would match that data with the switch data and its output would go low at pin 19 of chip U6 seen in Figure 2C. That low pulse will drive the relay driver chip U7B of Figure 2D. Driver chip U7B will generate a pulse having a width that is proportional to the time constant of R41 and C6, and preferably a 500 millisecond pulse width out of pin 6 of chip U7B. The pulse from chip U7B, when it goes low, will cause current to flow through the relay K1 and the resister to VCC and R42. Relay K1 will close for the duration of the pulse, and open again at the end of the pulse. Relay K1 is connected to terminal block JP2 at pins 1 and 2. Pins 1 and 2 in turn will be connected to the leads of an appliance, such as leads 18 of garage door movement mechanism 22 of Figure 3. In such a case, the pulse to relay K1 activates garage door movement mechanism 22 just as if button 38 were manually pressed and released.

The power supply interface circuitry 1100B, seen in Figure 2C, is composed of F1, which is a fuse for an external wall plug-in type of transformer. Fuse F1 inputs are connected to P1 and P2. P1 is the positive power source input and P2 is the ground input from the external power supply. The capacitor C14 is rated at 10 microfarads to provide ample ripple reduction and refiltering. After diode D3, a connection is made to V+ of the system of the receiver. In addition to the external power transformer power supply, there is an internal battery back up supply composed of BT1 and BT2 which yield a total of six volts. The diodes are provided so that whenever the external power supply is plugged in and is operating, the voltage would be slightly higher than the battery voltage in reverse bias of the diode D2. Thus, the batteries are not used whenever the external power supply is plugged in. In a failure of the external power supply, or when

the external power supply is unplugged, then current conducts through D2 to reverse bias D3. In sum, a short out in the external power supply would leave the receiver without a power due to the battery backup and. Batteries BT1, BT2 also insure that memory is refreshed so as to protect the memory as well as the programming that the user has put into the voice recognition memory chip U1. The refreshing enables the stored data to be retained within memory.

The present invention may be embodied in other specific forms without departing from its spirit or essential characteristics. The described embodiments are to be considered in all respects only as illustrative and not restrictive. The scope of the invention is, therefore, indicated by the appended claims rather than by the foregoing description. All changes which come within the meaning and range of equivalency of the claims are to be embraced within their scope.

What is claimed is:

CLAIMS:

1. A wireless remote switching system comprising:

transmitter means for broadcasting a carrier frequency, said transmitter means comprising:

means for inputting a new sound image data set;

means for modulating the new sound image data set to produce a modulated sound image data set;

means for broadcasting the carrier frequency with the modulated sound image data set superimposed thereon; and

means, manually operable, for initiating the modulating means to produce the modulated sound image data set and then to initiate the broadcasting means to broadcast the carrier frequency with the modulated sound image data set superimposed thereon;

receiver means for receiving the carrier frequency broadcast from said transmitter means, said receiver means comprising:

means for digitizing sound images;

means for storing digitized sound images;

security code input means for receiving a predetermined sound image data set;

programming means for causing the sound image digitizing means to accept the predetermined sound image data set and to output therefrom a digitized predetermined sound image data set, and for causing the means for storing digitized sound images to store therein the digitized predetermined sound image data set;

means for demodulating the modulated sound image data set superimposed on said carrier frequency to produce a demodulated sound image data set;

means for inputting the demodulated sound image data set to the means for digitizing sound image data so as to output therefrom a digitized received sound image data set;

means for determining the existence of a match by a comparison of the digitized received sound image data set with the digitized predetermined sound image data set; and

relay means, in electrical communication with the determining means, for throwing a switch when the determining means determines the existence of said match by said comparison.

2. The wireless system as defined in Claim 1, wherein said transmitter means further comprises:

wrap-around memory means for storing said new sound image data set at an address of a previously stored sound image data set;

wherein said inputting means comprises a digital keypad means for accepting input of a string of digits input by a user of said digital keypad, said string of digits comprising the new sound image data set to be stored in the wrap-around memory means at the address of said previously stored sound image data set; and

wherein said modulating means further comprises:

a means for generating a string of analog dual tone multifrequency (DTMF) signals from said new sound image data set stored in said wrap-around memory means, and for modulating said string of analog DTMF signals to produce said modulated sound image data set.

3. The wireless system as defined in Claim 2, wherein said transmitter means further comprises:

microphone means for detecting and amplifying an auditory sound image data set to produce an amplified auditory sound image data set; and

wherein the initiating means is further manually operable to initiate the microphone means to detect and amplify the auditory sound image data set and to initiate the modulating means to modulate the amplified auditory sound image data set to produce the modulated sound image data set.

4. The wireless system as defined in Claim 1, wherein said inputting means further comprises:

microphone means for detecting and amplifying an auditory sound image data set to produce the new sound image data set.

5. The wireless system as defined in Claim 1, wherein said transmitter further comprises:

wrap-around memory means for storing said new sound image data set at an address of a previously stored sound image data set;

wherein said inputting means inputs said new sound image data set to the wrap-around memory means so as to be stored therein at the address of said previously stored sound image data set; and

wherein said inputting means comprises:

a microphone means for detecting and amplifying an auditory sound image data set to produce an amplified auditory sound image data set;

means for digitizing said amplified auditory sound image data set to produce a digitized auditory sound image data set; and

means for storing said digitized auditory sound image data set at the address of said previously stored sound image data set.

6. The wireless system as defined in Claim 1, wherein said transmitter means further comprises:

wrap-around memory means for storing said new sound image data set at a keypad address of a previously stored sound image data set;

wherein said inputting means inputs said new sound image data set to the wrap-around memory means so as to be stored therein at the keypad address of said previously stored sound image data set; and

wherein the inputting means comprises:

a digital keypad means for accepting input of a string of digits;

means for generating a string of analog dual tone multifrequency (DTMF) signals from said string of digits input at said digital keypad means;

means for digitizing said string of analog DTMF signals to produce a string of digitized DTMF signals; and

means for storing said digitized DTMF signals at the keypad address of said previously stored sound image data set.

7. The wireless system as defined in Claim 6, wherein said inputting means further comprises:

microphone means for detecting and amplifying an input auditory sound image data set to produce an amplified auditory sound image data set;

audio digitizing means for digitizing the amplified auditory sound image data set to produce a digitized auditory sound image data set; and

means for storing said digitized auditory sound image data set at an audio address in said wrap-around memory means; and

wherein the initiating means is further manually operable to initiate the microphone means to produce the amplified auditory sound image data set, to initiate the audio digitizing means to produce the digitized auditory sound image data set, and to initiate the modulating means to modulate the digitized auditory sound image data set at the audio address in said wrap-around memory means to produce the modulated sound image data set.

8. The wireless system as defined in Claim 1, wherein the security code input means receives the predetermined sound image data set from the transmitter means via the modulated sound image data set superimposed on said carrier frequency.

9. The wireless system as defined in Claim 2, wherein the security code input means receives the predetermined sound image data set from the transmitter means via the modulated sound image data set superimposed on said carrier frequency.

10. The wireless system as defined in Claim 3, wherein the security code input means receives the predetermined sound image data set from the transmitter means via the modulated sound image data set superimposed on said carrier frequency.

11. The wireless system as defined in Claim 4, wherein the security code input means receives the predetermined sound image data set from the transmitter means via the modulated sound image data set superimposed on said carrier frequency.

12. The wireless system as defined in Claim 5, wherein the security code input means receives the predetermined sound image data set from the transmitter means via the modulated sound image data set superimposed on said carrier frequency.

13. The wireless system as defined in Claim 6, wherein the security code input means receives the predetermined sound image data set from the transmitter means via the modulated sound image data set superimposed on said carrier frequency.

14. The wireless system as defined in Claim 7, wherein the security code input means receives the predetermined sound image data set from the transmitter means via the modulated sound image data set superimposed on said carrier frequency.

15. The wireless system as defined in Claim 1, wherein the security code input means comprises:

a digital keypad means for accepting input of a string of digits and for generating therefrom the predetermined sound image data set comprising a string of analog dual tone multifrequency (DTMF) signals from said string of digits input at said digital keypad means.

16. The wireless system as defined in Claim 2, wherein the security code input means comprises:

a digital keypad means for accepting input of a string of digits and for generating therefrom the predetermined sound image data set comprising a string of analog dual tone multifrequency (DTMF) signals from said string of digits input at said digital keypad means.

17. The wireless system as defined in Claim 3, wherein the security code input means comprises:

a digital keypad means for accepting input of a string of digits and for generating therefrom the predetermined sound image data set comprising a string of analog dual tone multifrequency (DTMF) signals from said string of digits input at said digital keypad means.

18. The wireless system as defined in Claim 4, wherein the security code input means comprises:

a digital keypad means for accepting input of a string of digits and for generating therefrom the predetermined sound image data set comprising a string of analog dual tone multifrequency (DTMF) signals from said string of digits input at said digital keypad means.

19. The wireless system as defined in Claim 5, wherein the security code input means comprises:

a digital keypad means for accepting input of a string of digits and for generating therefrom the predetermined sound image data set comprising a string of analog dual tone multifrequency (DTMF) signals from said string of digits input at said digital keypad means.

20. The wireless system as defined in Claim 6, wherein the security code input means comprises:

a digital keypad means for accepting input of a string of digits and for generating therefrom the predetermined sound image data set comprising a string of analog dual tone multifrequency (DTMF) signals from said string of digits input at said digital keypad means.

21. The wireless system as defined in Claim 7, wherein the security code input means comprises:

a digital keypad means for accepting input of a string of digits and for generating therefrom the predetermined sound image data set comprising a string of analog dual tone multifrequency (DTMF) signals from said string of digits input at said digital keypad means.

22. The wireless system as defined in Claim 1, wherein the security code input means comprises:

a microphone means for detecting and amplifying an auditory sound image data set to produce therefrom the predetermined sound image data set.

23. The wireless system as defined in Claim 2, wherein the security code input means comprises:

a microphone means for detecting and amplifying an auditory sound image data set to produce therefrom the predetermined sound image data set.

24. The wireless system as defined in Claim 3, wherein the security code input means comprises:

a microphone means for detecting and amplifying an auditory sound image data set to produce therefrom the predetermined sound image data set.

25. The wireless system as defined in Claim 4, wherein the security code input means comprises:

a microphone means for detecting and amplifying an auditory sound image data set to produce therefrom the predetermined sound image data set.

26. The wireless system as defined in Claim 5, wherein the security code input means comprises:

a microphone means for detecting and amplifying an auditory sound image data set to produce therefrom the predetermined sound image data set.

27. The wireless system as defined in Claim 6, wherein the security code input means comprises:

a microphone means for detecting and amplifying an auditory sound image data set to produce therefrom the predetermined sound image data set.

28. The wireless system as defined in Claim 7, wherein the security code input means comprises:

a microphone means for detecting and amplifying an auditory sound image data set to produce therefrom the predetermined sound image data set.

29. The wireless system as defined in Claim 1, wherein the security code input means comprises:

a digital keypad means for accepting input of a string of digits and for generating therefrom the predetermined sound image data set comprising a string of analog dual tone multifrequency (DTMF) signals from said string of digits input at said digital keypad means; and

a microphone means for detecting and amplifying an auditory sound image data set to produce therefrom the predetermined sound image data set.

30. The wireless system as defined in Claim 2, wherein the security code input means comprises:

a digital keypad means for accepting input of a string of digits and for generating therefrom the predetermined sound image data set comprising a string

of analog dual tone multifrequency (DTMF) signals from said string of digits input at said digital keypad means; and

a microphone means for detecting and amplifying an auditory sound image data set to produce therefrom the predetermined sound image data set.

31. The wireless system as defined in Claim 3, wherein the security code input means comprises:

a digital keypad means for accepting input of a string of digits and for generating therefrom the predetermined sound image data set comprising a string of analog dual tone multifrequency (DTMF) signals from said string of digits input at said digital keypad means; and

a microphone means for detecting and amplifying an auditory sound image data set to produce therefrom the predetermined sound image data set.

32. The wireless system as defined in Claim 4, wherein the security code input means comprises:

a digital keypad means for accepting input of a string of digits and for generating therefrom the predetermined sound image data set comprising a string of analog dual tone multifrequency (DTMF) signals from said string of digits input at said digital keypad means; and

a microphone means for detecting and amplifying an auditory sound image data set to produce therefrom the predetermined sound image data set.

33. The wireless system as defined in Claim 5, wherein the security code input means comprises:

a digital keypad means for accepting input of a string of digits and for generating therefrom the predetermined sound image data set comprising a string of analog dual tone multifrequency (DTMF) signals from said string of digits input at said digital keypad means; and

a microphone means for detecting and amplifying an auditory sound image data set to produce therefrom the predetermined sound image data set.

34. The wireless system as defined in Claim 6, wherein the security code input means comprises:

a digital keypad means for accepting input of a string of digits and for generating therefrom the predetermined sound image data set comprising a string of analog dual tone multifrequency (DTMF) signals from said string of digits input at said digital keypad means; and

a microphone means for detecting and amplifying an auditory sound image data set to produce therefrom the predetermined sound image data set.

35. The wireless system as defined in Claim 7, wherein the security code input means comprises:

a digital keypad means for accepting input of a string of digits and for generating therefrom the predetermined sound image data set comprising a string of analog dual tone multifrequency (DTMF) signals from said string of digits input at said digital keypad means; and

a microphone means for detecting and amplifying an auditory sound image data set to produce therefrom the predetermined sound image data set.

36. A wireless remote switching system comprising:

transmitter means for broadcasting a carrier frequency, said transmitter means comprising:

means for inputting a new sound image data set comprising:

a digital keypad means for accepting input of a string of digits input by a user of said digital keypad, said string of digits comprising the new sound image data set;

wrap-around memory means for storing said new sound image data set at an address of a previously stored sound image data set;

means for modulating the new sound image data set to produce a modulated sound image data set, comprising:

a means for generating a string of analog dual tone multifrequency (DTMF) signals from said new sound image data set stored in said wrap-around memory means, and for modulating said string of analog DTMF signals to produce said modulated sound image data set;

means for broadcasting the carrier frequency with the modulated sound image data set superimposed thereon;

means, manually operable, for initiating the modulating means to produce the modulated sound image data set and then to initiate the broadcasting means to broadcast the carrier frequency with the modulated sound image data set superimposed thereon;

receiver means for receiving the carrier frequency broadcast from said transmitter means, said receiver means comprising:

means for digitizing sound images;

means for storing digitized sound images;

security code input means for receiving a predetermined sound image data set comprising:

a digital keypad means for accepting input of a string of digits and for generating therefrom the predetermined sound image data set comprising a string of analog dual tone multifrequency (DTMF) signals from said string of digits input at said digital keypad means;

programming means for causing the sound image digitizing means to accept the predetermined sound image data set and to output therefrom a digitized predetermined sound image data set, and for causing the means for storing digitized sound images to store therein the digitized predetermined sound image data set;

means for demodulating the modulated sound image data set superimposed on said carrier frequency to produce a demodulated sound image data set;

means for inputting the demodulated sound image data set to the means for digitizing sound image data so as to output therefrom a digitized received sound image data set;

means for determining the existence of a match by a comparison of the digitized received

sound image data set with the digitized predetermined sound image data set; and

relay means, in electrical communication with the determining means, for throwing a switch when the determining means determines the existence of said match by said comparison.

37. A wireless remote switching system comprising:

transmitter means for broadcasting a carrier frequency, said transmitter means comprising:

means for inputting a new sound image data set comprising:

a digital keypad means for accepting input of a string of digits;

means for generating a string of analog dual tone multifrequency (DTMF) signals from said string of digits input at said digital keypad means;

means for digitizing said string of analog DTMF signals to produce a string of digitized DTMF signals;

means for storing said digitized DTMF signals at a keypad address of a previously stored sound image data set;

wrap-around memory means for storing the new sound image data set at the keypad address of the previously stored sound image data set, said inputting means inputting said new sound image data set to the wrap-around memory means so as to be stored therein at the keypad address of the previously stored sound image data set;

microphone means for detecting and amplifying an input auditory sound image data set to produce an amplified auditory sound image data set;

audio digitizing means for digitizing the amplified auditory sound image data set to produce a digitized auditory sound image data set; and

means for storing said digitized auditory sound image data set at an audio address in said wrap-around memory means;

means for modulating the new sound image data set to produce a modulated sound image data set;

means for broadcasting the carrier frequency with the modulated sound image data set superimposed thereon;

means, manually operable, for initiating the modulating means to produce the modulated sound image data set and then to initiate the broadcasting means to broadcast the carrier frequency with the modulated sound image data set superimposed thereon;

and wherein the initiating means is further manually operable to initiate the microphone means to produce the amplified auditory sound image data set, to initiate the audio digitizing means to produce the digitized auditory sound image data set, and to initiate the modulating means to modulate the digitized auditory sound image data set at the audio address in said wrap-around memory means to produce the modulated sound image data set;

receiver means for receiving the carrier frequency broadcast from said transmitter means, said receiver means comprising:

means for digitizing sound images;

means for storing digitized sound images;

security code input means for receiving a predetermined sound image data set comprising:

a digital keypad means for accepting input of a string of digits and for generating therefrom the predetermined sound image data set comprising a string of analog dual tone multifrequency (DTMF) signals from said string of digits input at said digital keypad means; and

a microphone means for detecting and amplifying an auditory sound image data set to produce therefrom the predetermined sound image data set;

programming means for causing the sound image digitizing means to accept the predetermined sound image data set and to output therefrom a digitized predetermined sound image data set, and for causing the means for storing digitized sound images to store therein the digitized predetermined sound image data set;

means for demodulating the modulated sound image data set superimposed on said carrier frequency to produce a demodulated sound image data set;

means for inputting the demodulated sound image data set to the means for digitizing sound image data so as to output therefrom a digitized received sound image data set;

means for determining the existence of a match by a comparison of the digitized received sound image data set with the digitized predetermined sound image data set; and

relay means, in electrical communication with the determining means, for throwing a switch when the determining means determines the existence of said match by said comparison.

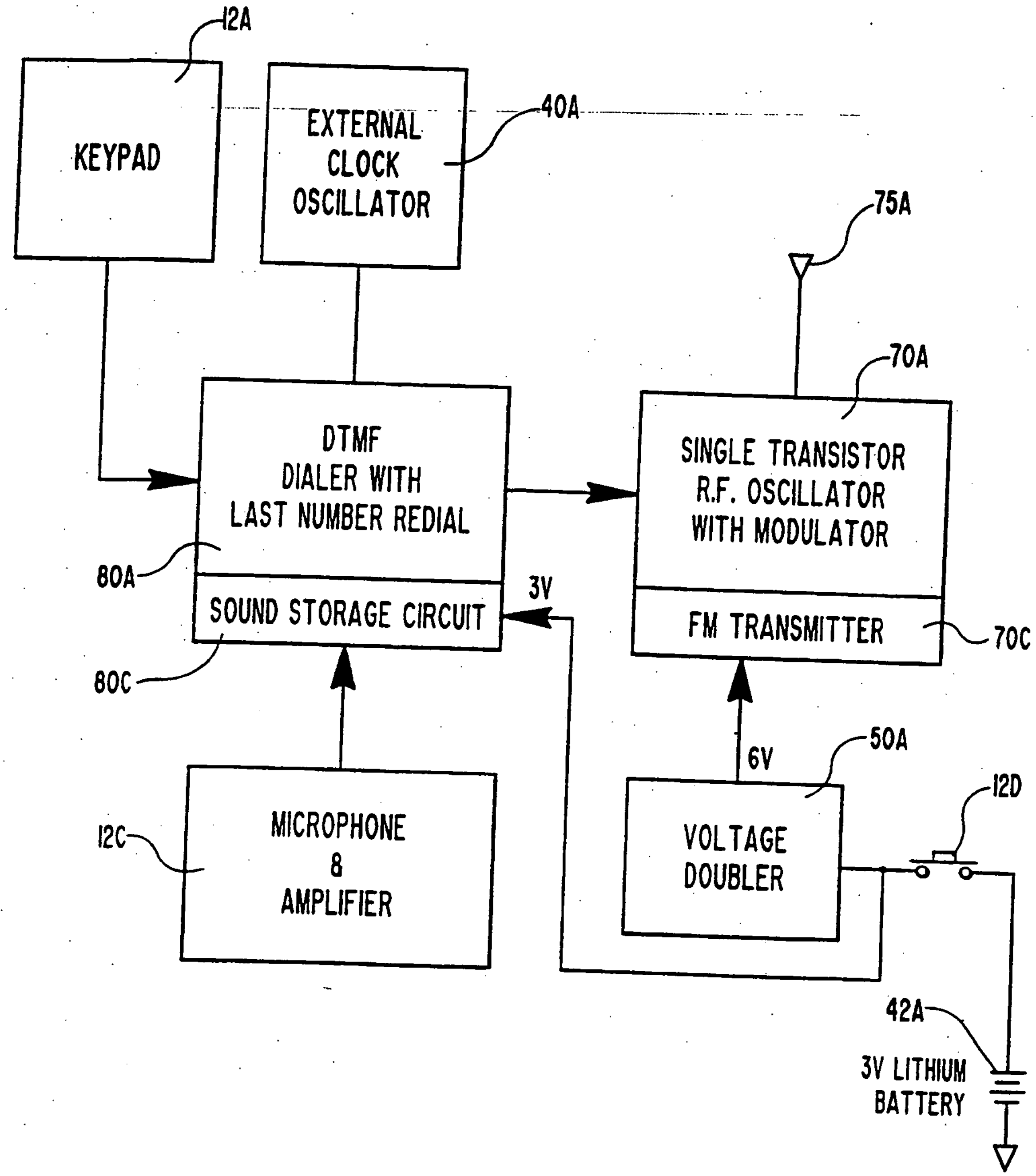
12A
KEYPAD
EXTERNAL CLOCK OSCILLATOR
40A
75A
70A
DTMF DIALER WITH LAST NUMBER REDIAL
SINGLE TRANSISTOR R.F. OSCILLATOR WITH MODULATOR
80A
SOUND STORAGE CIRCUIT
3V
FM TRANSMITTER
70C
80C
6V
50A
12D
12C
MICROPHONE & AMPLIFIER
VOLTAGE DOUBLER
42A
3V LITHIUM BATTERY

FIG. 1

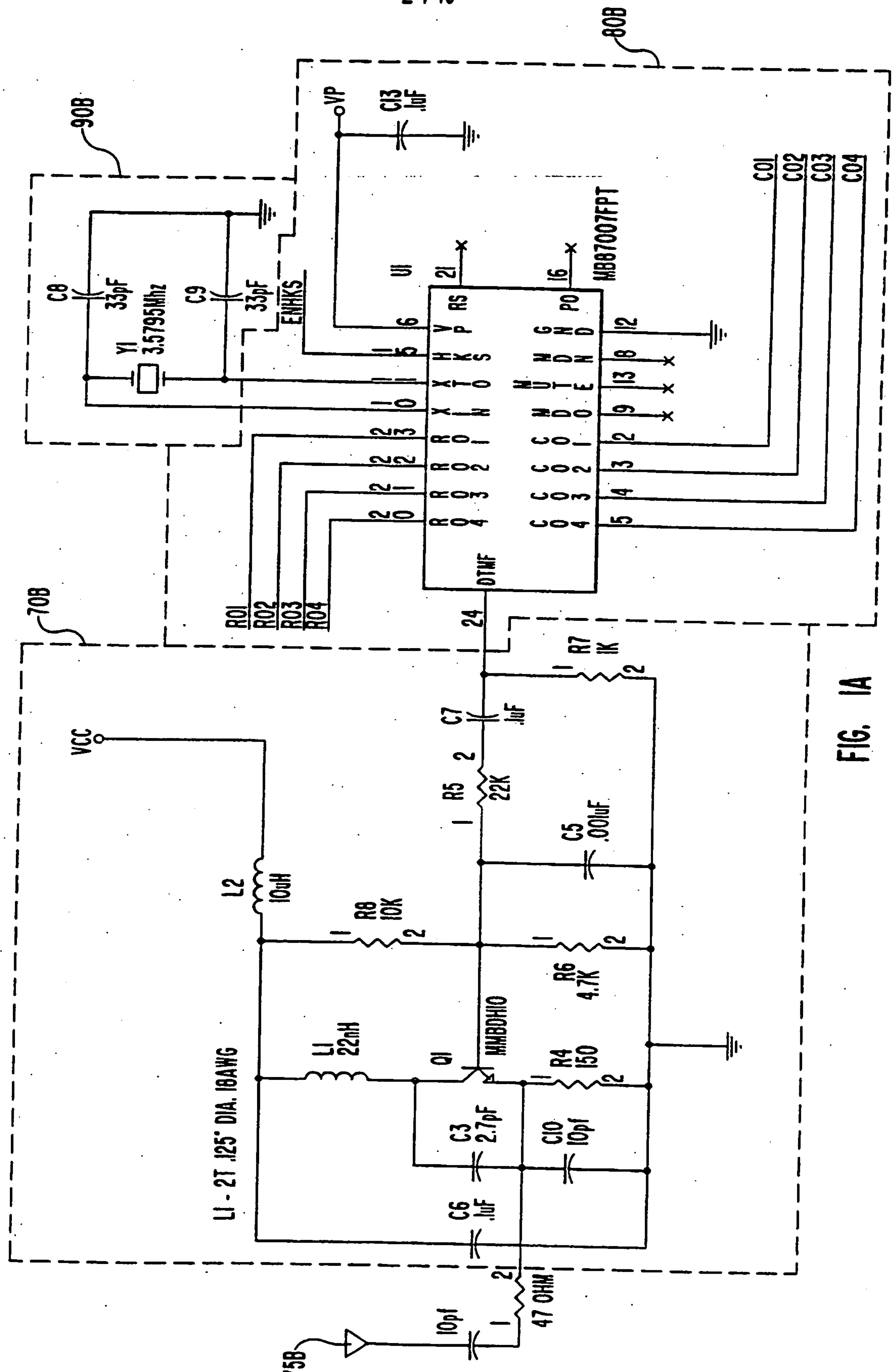
80B
90B
70B
75B
VP
C13 .1uF
C01
C02
C03
C04
MB87007FPT
U1
C8 33pF
C9 33pF
Y1 3.5795Mhz
ENHKS
RS
PO
R01
R02
R03
R04
DTMF
R7 1K
C7 .1uF
VCC
R5 22K
C5 .001uF
L2 10uH
R8 10K
R6 4.7K
MMBOH10
L1 22nH
Q1
R4 150
C3 2.7pF
C10 10pf
C6 .1uF
L1 - 2T .125" DIA. 18AWG
47 OHM
10pf

FIG. 1A

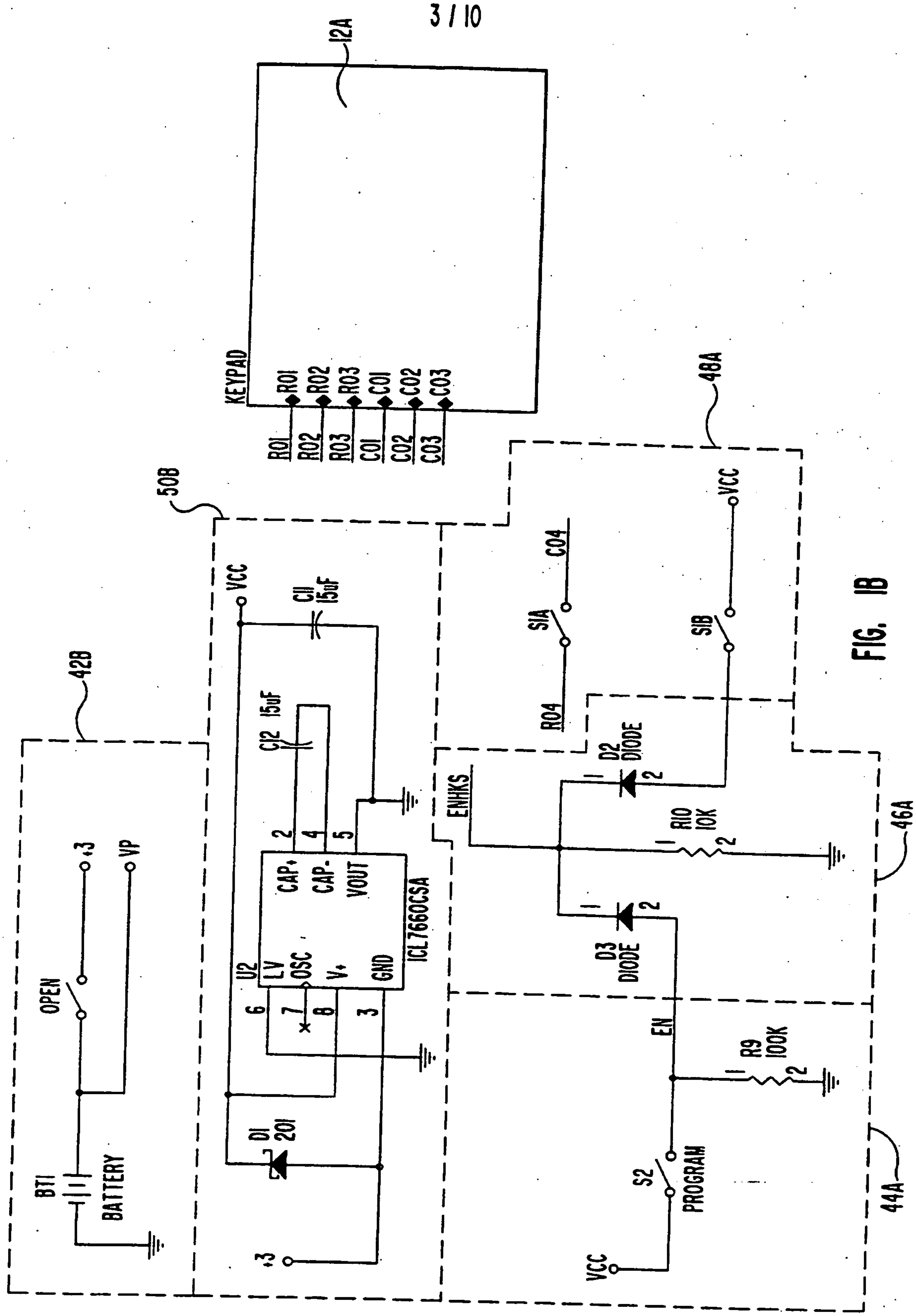
12A
KEYPAD
R01
R02
R03
C01
C02
C03
50B
48A
42B
46A
44A
VCC
C11 15uF
C12 15uF
U2
LV
OSC
V+
GND
CAP+
CAP-
VOUT
ICL7660CSA
D1 201
+3
VP
OPEN
BT1
BATTERY
C04
S1A
S1B
R04
D2 DIODE
ENHKS
R10 10K
D3 DIODE
EN
R9 100K
S2
PROGRAM

FIG. 1B

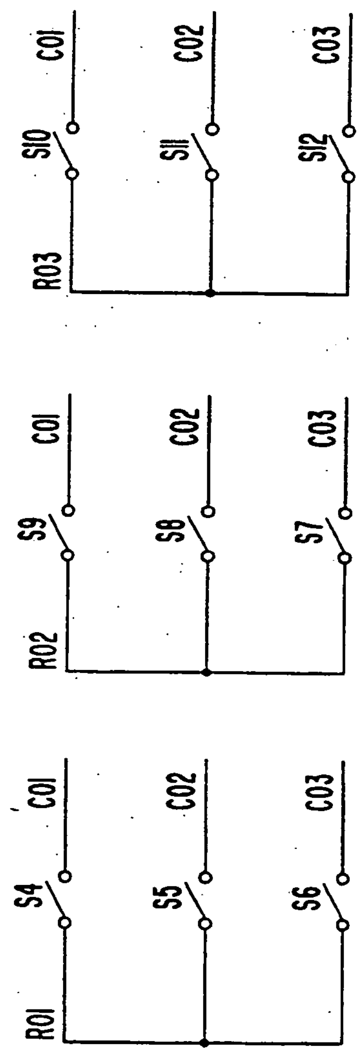
RO3
S10
S11
S12
CO1
CO2
CO3
RO2
S9
S8
S7
CO1
CO2
CO3
RO1
S4
S5
S6
CO1
CO2
CO3

FIG. 1C

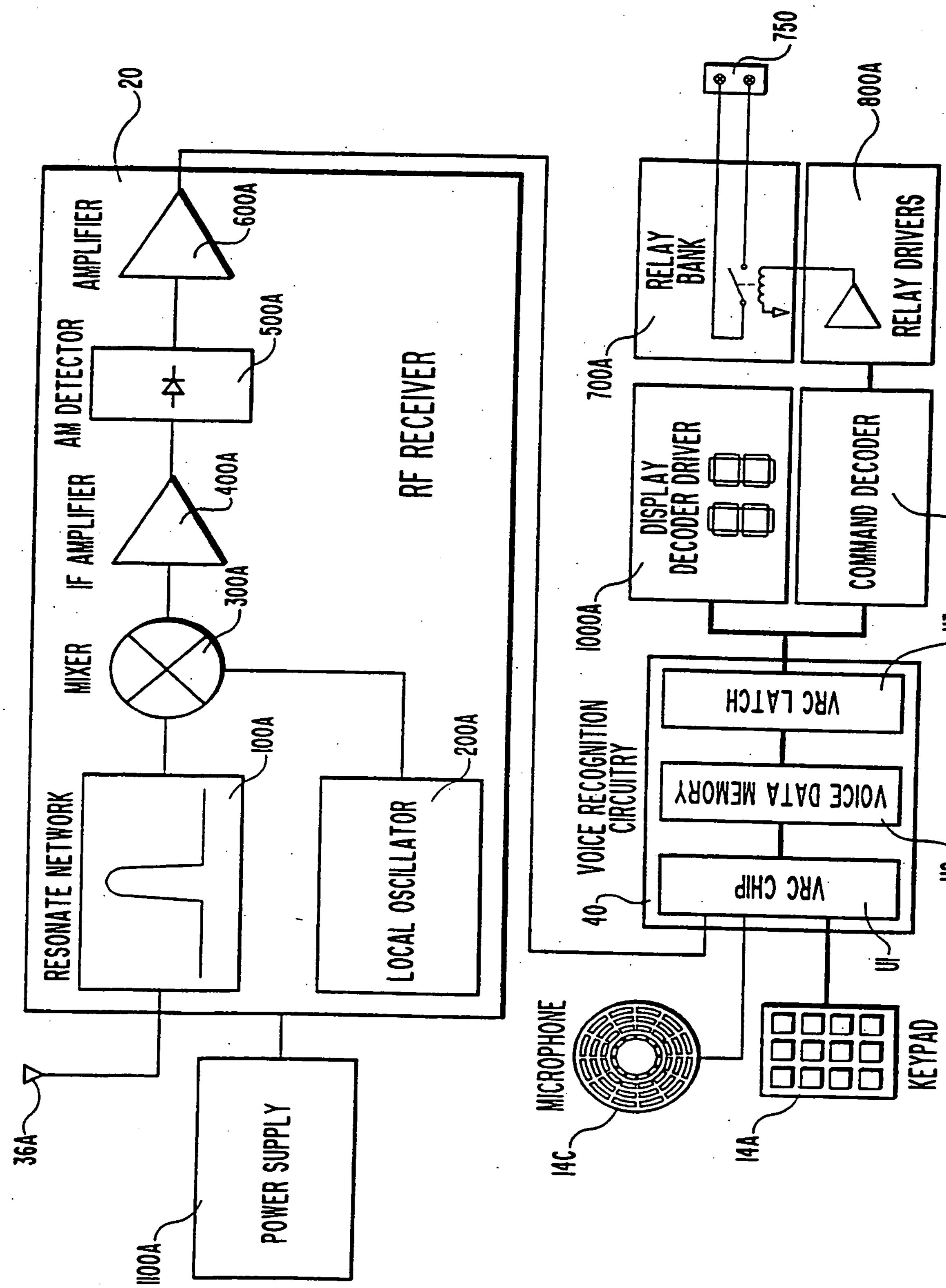
20
AMPLIFIER
600A
AM DETECTOR
500A
IF AMPLIFIER
400A
MIXER
300A
RF RECEIVER
RESONATE NETWORK
100A
LOCAL OSCILLATOR
200A
36A
POWER SUPPLY
1100A
750
800A
RELAY BANK
700A
RELAY DRIVERS
DISPLAY DECODER DRIVER
1000A
COMMAND DECODER
900A
U3
VRC LATCH
VOICE RECOGNITION CIRCUITRY
VOICE DATA MEMORY
U2
VRC CHIP
40
U1
MICROPHONE
14C
KEYPAD
14A

FIG. 2

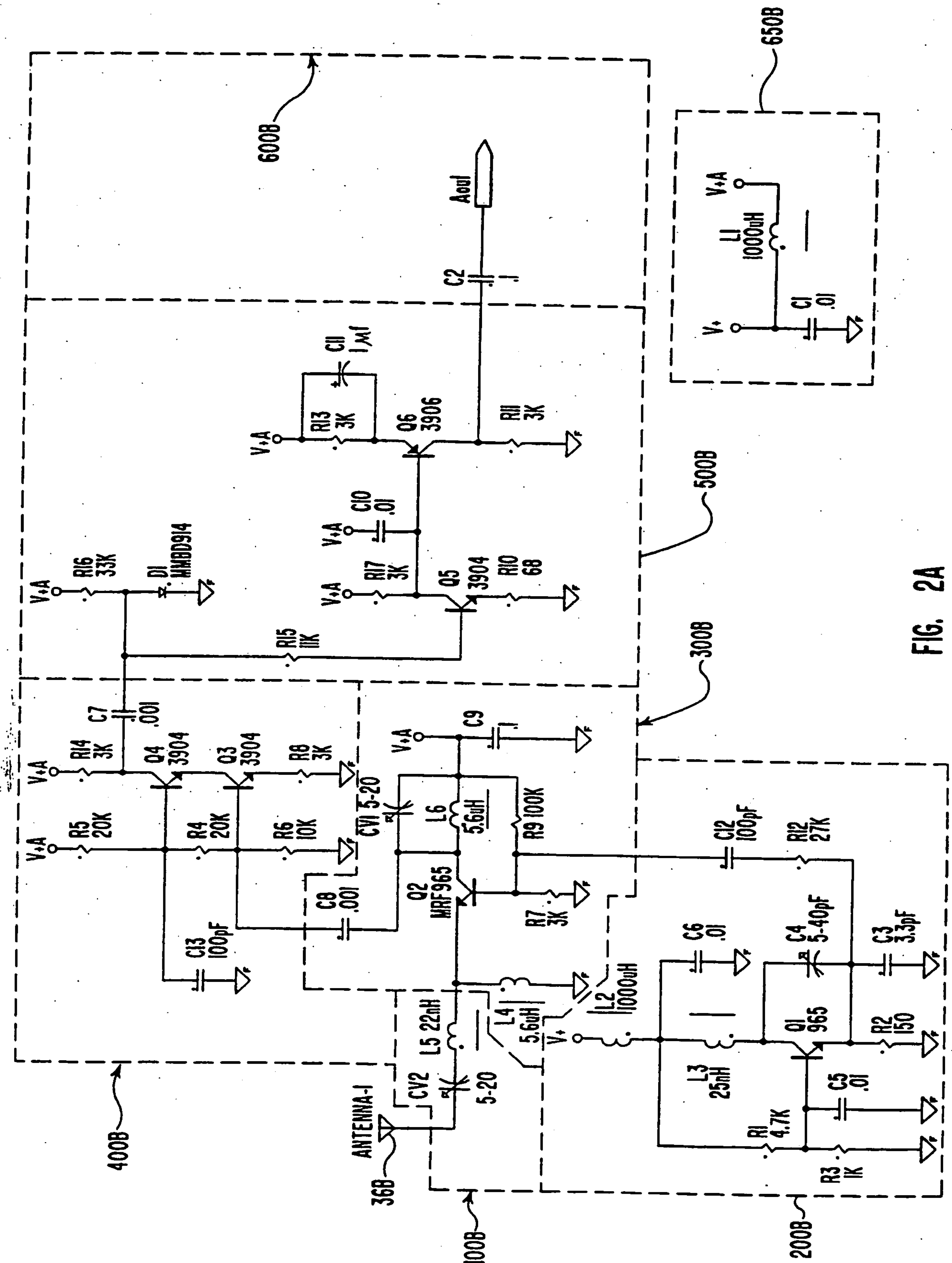
600B
Aout
C2
.1
650B
V+A
L1
1000uH
V+
C1
.01
500B
C11
1µf
R13
3K
Q6
3906
R11
3K
V+A
C10
.01
R16
33K
D1
MMBD914
R17
3K
Q5
3904
R10
68
R15
11K
300B
C7
.001
R14
3K
Q4
3904
Q3
3904
R8
3K
C9
.1
R5
20K
R4
20K
R6
10K
CV1 5-20
L6
5.6uH
R9 100K
C12
100pF
R12
27K
Q2
MRF965
R7
3K
C8
.001
C13
100pF
C6
.01
C4
5-40pF
C3
3.3pF
L2
1000uH
L4
5.6uH
L5 22nH
Q1
965
R12
150
L3
25nH
C5
.01
CV2
5-20
ANTENNA-1
R1
4.7K
R3
1K
36B
400B
100B
200B

FIG. 2A

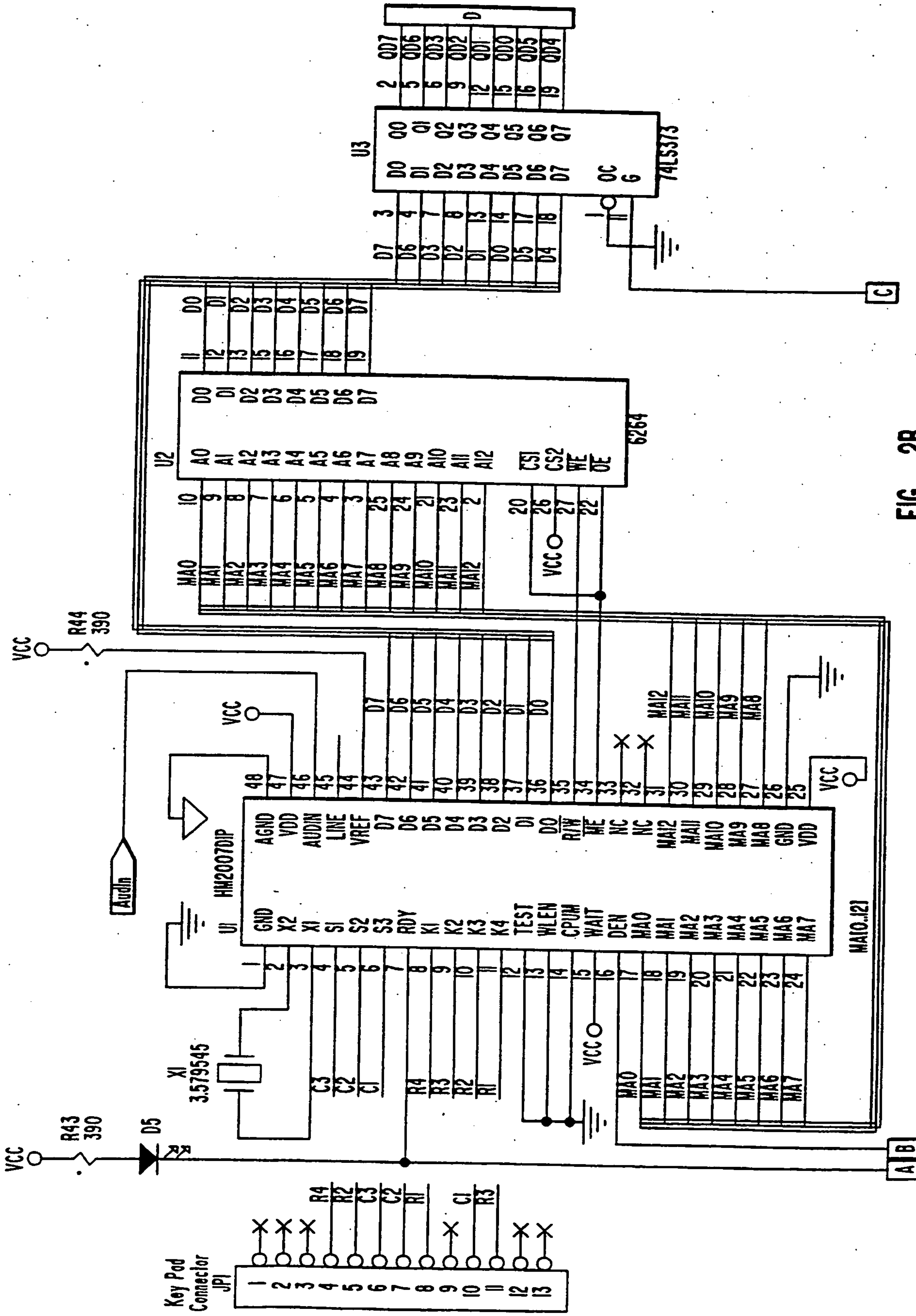
U1
HM2007DIP
U2
6264
U3
74LS373
X1
3.579545
R43
390
R44
390
D5
VCC
AudIn
Key Pad Connector JP1

FIG. 2B

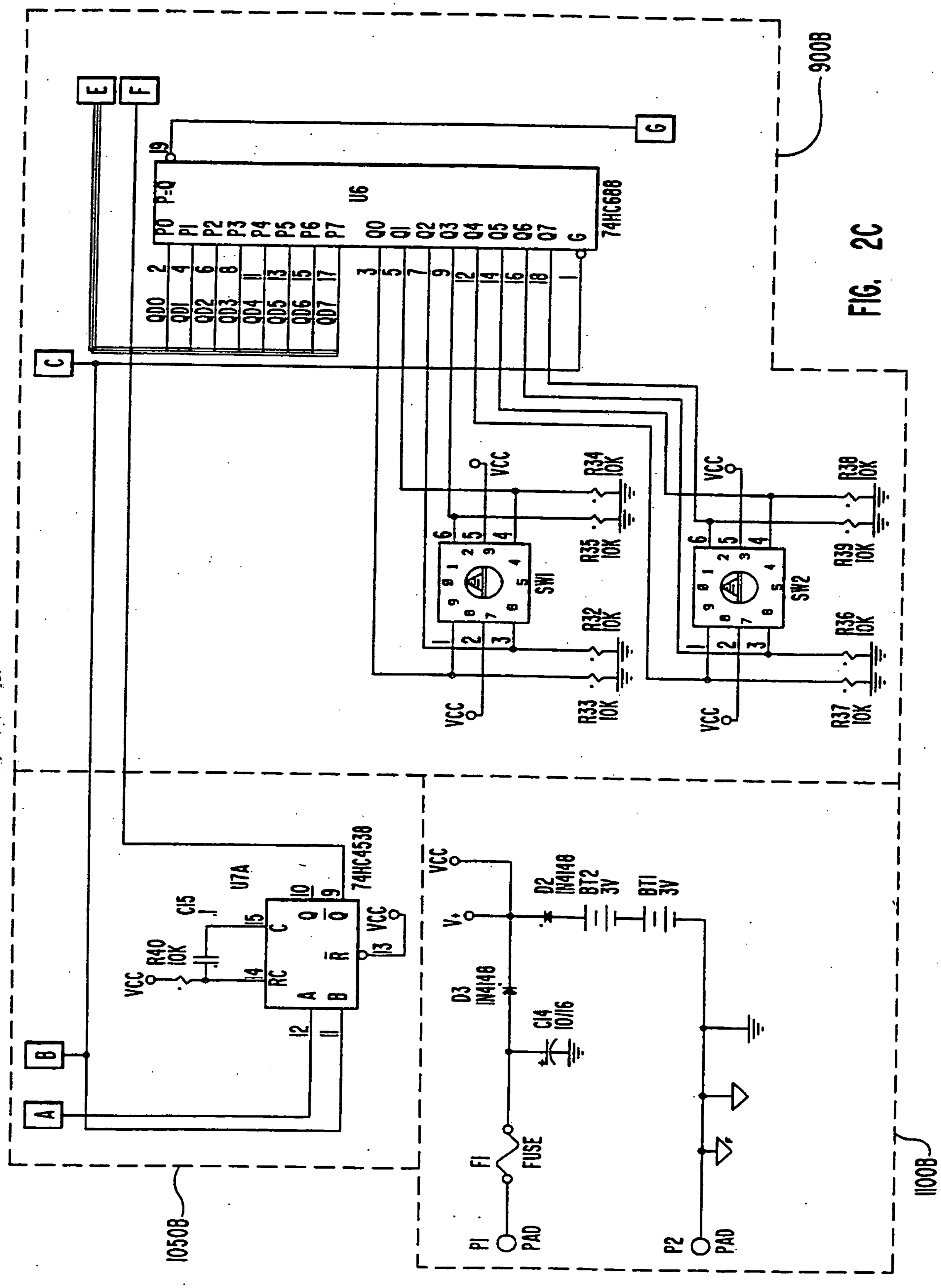
900B
1050B
1100B
U6
74HC688
P=Q
U7A
74HC4538
SW1
SW2
VCC
FUSE
PAD
P1
P2
F1
D2
D3
IN4148
BT1
BT2
3V
C14
C15
R40
10K

FIG. 2C

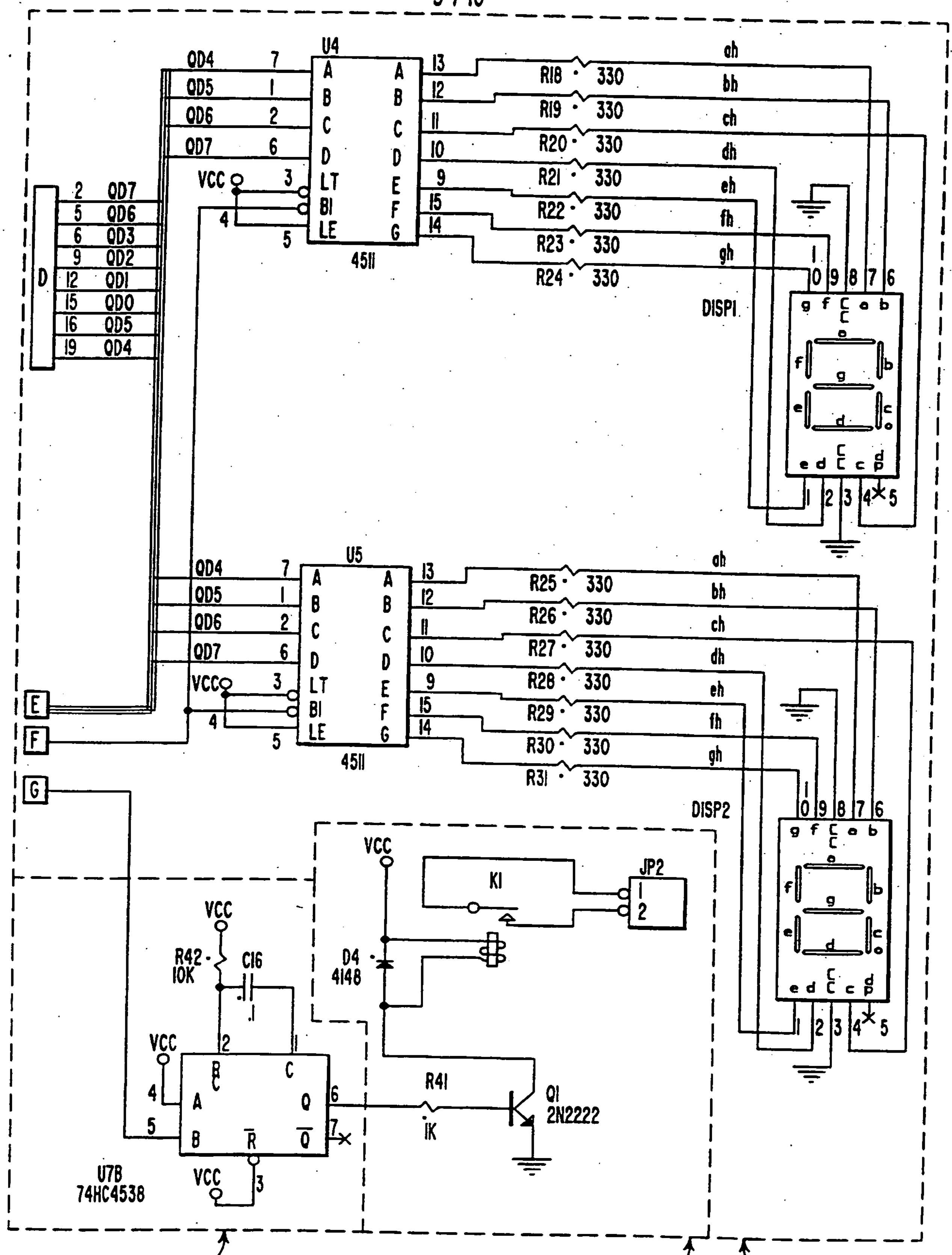
U4
QD4
QD5
QD6
QD7
VCC
A
B
C
D
LT
BI
LE
E
F
G
4511
R18 330
R19 330
R20 330
R21 330
R22 330
R23 330
R24 330
ah
bh
ch
dh
eh
fh
gh
DISP1
D
QD7
QD6
QD3
QD2
QD1
QD0
QD5
QD4
U5
4511
R25 330
R26 330
R27 330
R28 330
R29 330
R30 330
R31 330
DISP2
E
F
G
VCC
K1
JP2
D4
4148
R41
1K
Q1
2N2222
R42
10K
C16
.1
Q
R
U7B
74HC4538
800B
700B
1000B

FIG. 2D

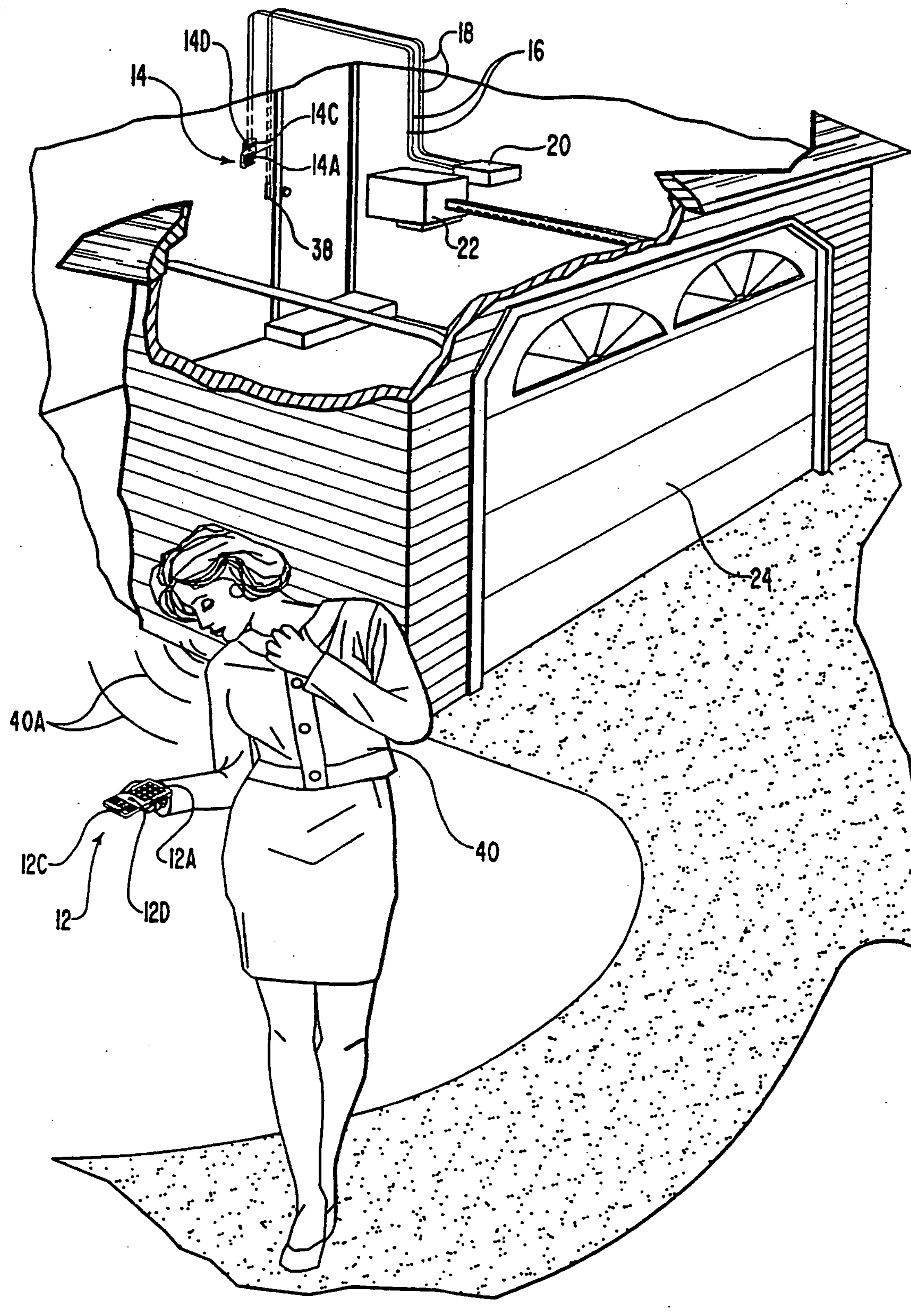

FIG. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US94/13831

A. CLASSIFICATION OF SUBJECT MATTER

IPC(5) :H04Q 7/00; G06F 3/16
US CL :340/825.31, 825.57, 825.69; 381/110; 379/88
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 340/825.31, 825.57, 825.69, 825.72; 381/42, 110; 379/67, 74, 77, 88,91, 95, 102

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

APS

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US, A, 4,988,992 (HEITSCHEL ET AL.) 29 JANUARY 1991, COL. 2, LINE 51- COL 4 LINE 56.	1-37
Y	US, A, 5,252,960 (DUHAME) 12 OCTOBER 1993, COL 3, LINE 15- COL 5, LINE 47.	1-37
Y	US, A, 5,199,080 (KIMURA ET AL.) 30 MARCH 1993, COL. 3, LINE 31- COL 4, LINE 6.	1-37
Y	US, A, 4,750,118 (HEITSCHEL ET AL.) 07 JUNE 1988, COL. 2, LINE 66- COL. 3, LINE 7.	8-14
Y	US, A, 5,220,595, (UEHARA) 15 JUNE 1993, COL. 1, LINES 14-42.	15-37

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be part of particular relevance

"E" earlier document published on or after the international filing date

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
09 FEBRUARY 1995	20 MAR 1995

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